THE HIGH SCHOOL JOURNAL

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EDITORIAL

WITH this issue THE HIGH SCHOOL JOURNAL celebrates the beginning of its twenty-first year of publication.

THE JOURNAL itself succeeded an earlier quarterly, The High School Bulletin, published by the University of North Carolina from 1910 through 1917, under the editorship of Nathan W. Walker, then State high school inspector. As the experimental stage of North Carolina State high schools came to an end, and Mr. Walker himself joined the University staff, it was felt that the Bulletin had become inadequate to render the best type of service; and as a result our magazine, under its present name, took form. Prof. Walker remained as its editorial leader until illness forced his retirement in 1935.

Brief quotations from the first editorial will serve now, as then, to indicate the general policies that have guided, and still guide its destiny:

"There are, in the opinion of the JOURNAL, two problems in the field of secondary education in North Carolina and the South which are of prime importance, and to which it purposes in the main to devote its pages. The first of these is that of securing better teaching. Too many teachers are still chained to textbooks and to lecture notes of their own college days. . . . A second problem, vital to the success of the high school, is that of better formulating its functions in a democratic civilization. Is it that best adapted to its task? Is the high school organized and administered in ways which enable it best to fulfill its mission? Can its relations with the elementary school and with the colleges be improved? . . . The JOURNAL will, so far as it can, aid the high schools in their task of adapting themselves sanely to the needs of a society which is witnessing a great rebirth of democracy and idealism. . . . But the JOURNAL will not lose sight of the fact that North Carolina high schools are part

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HISTORICAL BACKGROUNDS OF EDUCATIONAL THEORY

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IT IS natural that this should be a time of widespread educational discussion. College and university curricula and instruction methods are especially under fire. The Swarthmore Plan, the Chicago Plan, the Columbia Plan, the Minnesota Plan, the Rollins Plan, are terms in common use and signify the extent of our experimental mood. Middlebury College, Bennington College, Stevens College, Black Mountain College, Brookwood Labor College are the advance guards of pioneer thinking.

In every college faculty partisans for these and other plans are readily discovered. Almost daily some faculty committee is halted in its work by interested, and sometimes acrimonious, discussion of the merits of voluntary class attendance, the essential importance of mathematics or Latin or liberal education, or the moral value of hard study of a distasteful but required subject. All too often these positions are not taken as the result of scientific knowledge, or careful analysis and broadly based judgment, but reflect our prejudices, the vested interests of our departments, or our recollection of how we were educated—which therefore means that others should be educated likewise or that others should be educated differently. Positions are bolstered up by an isolated instance of a student who did so and so, or a broad generalization that these students are so and so. We have courses in which conflicting forms of economic theory are carefully analyzed. We use the scientific method and the scholarly point of view as vantage ground from which to judge practices of government and the courts. We frequently lament the prevalence of dogmatism and vested interests in ecclesiastical institutions. Is it too much to hope that college faculties themselves should undergo the discipline they recommend, and bring historical perspective, scientific analysis and experimentation, and philosophic comprehensiveness and tolerance to the criticism of their own vested interests, their own institutionalisms? Let us turn to the parents of this great enterprise we administer.

In its simplest terms education is the development and equipment of the child for dealing with his environment. Since the older generation teaches the younger, the conscious aims of education are usually concerned with handing on to posterity the accumulated experi-

ence of the past. Whether that experience will develop youth or cramp it, or whether inherited habits will fit or unfit youth for the new elements in its own environment is usually not considered. Accordingly, education, although in theory essentially as just defined, as practiced is more accurately described as the effort to hand down the social inheritance of knowledge, skills, and appreciations. This aim gives to education and its institutional expressions a fundamentally conservative cast.

Particularly in the primitive beginnings of educational practice does the conservative or static aim predominate. The imitative games give place in the early teens of the primitive adolescent to a real share in the round of adult duties, and the *method of instruction is exact imitation.* To perform all the work, hunting, fighting, dressing, ornamentation, or courtship *exactly* as is the custom of the tribe is the limit and content of youthful ambition and parental concern. This growth from infancy to adulthood through play and imitation usually is completed and symbolized in tribal rites of initiation.

Apparently we have in such a body of custom the primitive roots of many institutions of civilization. As the religious and historical lore surrounding the symbols and rites increases in volume its preservation demands recording symbols commonly understood by the leaders of the ceremonies. This is the beginning of writing. The special knowledge required for carrying out such elaborate rites becomes the possession of a group, the progenitors of teachers and priests, a budding profession. In the most primitive social groups of which records exist we find, then, a small body of written or pictured symbols to the understanding and perpetuation of which a select group of the tribe give a large portion of their time. The importance of this embryonic literature is its content of tribal wisdom, the slowly accumulated techniques for getting along with gods, men, and things, all of which are likely to be hostile if not treated in just the ways found successful by the ancients.

A casual study of these early folkways shows how clearly the consciousness of the savage is limited to the present. There is little sense of time. The 'ancient' is frequently what happened a year or so previously. The future is equally ignored. The blind obedience of youth to present age is almost the whole of morality, education, and individual ambition.

As we turn to the next oldest educational institution and practices, the oriental, we can see the flowering of these primitive seeds.

By the time of the Old Testament era there had evolved in most oriental groups great bodies of literature, all of which was regarded as sacred. The Vedas of the Hindoos, the Law of the Jews, the Say-

ings of the Sages in China, all of these are obviously the outgrowth of the primitive wisdom symbols. They appear at this stage as a great antiquity and are overlaid with successive generations of comment, as in the plains of Mespotamia many cities stand one on the other.

The antiquity of these sacred writings is clearly recognized and the consciousness of the people reaches backward into a rich past. Definitely to maintain and understand that past and reincarnate it in each generation is the clear aim of Chinese and Hindoo educational systems. This is to be accomplished by youth's 'learning' the literature in which the past is recorded. While the 'sages' or the 'rabbis' or 'mahatmas' may differ in their interpretation of ancient writings whose early meaning may be really inaccessible, there is no contemporary authority except of interpretation. This was the background against which they exclaimed of Jesus, "He speaks as one with authority, not as the scribes and Pharisees!" The proud boast of the time was, "All this have I kept from my youth up."

Even in 1903, 960,000 Chinese competed for 1839 degrees with position awarded to those most successful in memorizing the nine sacred classics with commentaries, and in reproducing the style of the original writings.

That this education for perpetuation of a culture produces a certain stability and richness of civilization is apparent from the history of China. However, when the nation is not isolated in a great agricultural area as was China, but is constantly threatened by natural forces as were the Hebrews and Arabs, or in constant contact with diverse cultures as were the Persians and Greeks, such education proves inadequate to equip youth or maintain the culture. Accordingly with the Persians and Greeks began the characteristically western or European kind of educational practice.

Primitive education in a partial way and oriental education in a grand way had solved the first great task attendant on early cultural beginnings, the task of conserving and perpetuating such beginnings in the midst of severe natural forces and savage human groups. A religious view and an educational aim which would make possible advance in civilization through the assimilation of alien cultures and through individual experimentation is quite another and a major achievement.

Education for the future contrasted with that for and of the past appeared in some measure among the Hebrews and Persians. Among both peoples the basic religious and moral ideas were similarly concerned with the struggle between gods of light and of darkness. In this struggle man must take sides and fit himself for an active life of

fighting against evil animals, evil men, and evil conditions. The primary aim of society and accordingly of education was not the reproduction of a past golden age, nor the preservation of a recent past or of the present, but rather the rapid remodeling of the world to a complete triumph of truth, justice, and light. In this struggle all the individual's energies, physical, mental, and moral were commandeered. However, the ideals and forms to which the individual dedicated his life were still ancient, having been revealed of old. The individual's part was still receptivity and obedience. To act daily in accordance with ancient formulas was still the content of education as in primitive society, a predominantly ethical implication as contrasted with the retreat from society and action of India or the preoccupation with style, ceremony, and etiquette of China. It was emphasis on building a social system more just than the present in the Near East in contrast to the emphasis on preserving the present system or reproducing a past system in the Far East.

However, in Greece for the first time there appeared the typically western idea of progress rather than stability, and individual development rather than conformity. The germ of Greek educational theory appears in Homer in the two ideal characters, Achilles the man of action and Odysseus the man of wisdom. However, the ideal was really the combination of the two in one person. Phoenix says of his instruction of Achilles:

"In all which I was set by him to instruct thee my son.
"That thou mightst speak, when speech was fit, and do
when deeds were done;
"Not sit as dumb for want of words, idle, for skill to move."

In this double ideal we may see a fundamental contrast to the educational aims previously considered.

The emphasis on wisdom is present, but a wisdom more allied to individual sagacity than to the memorization of the sayings of the ancients. How to do things is present, but to act rightly is seen not merely as a necessity for survival but as the basis of a career of distinction. A comparison of Homer on the one hand with the Old Testament of the Hebrews, the Upanishads of the Hindoos, and the Chinese Sacred Writings on the other, brings into clear relief the Greek faith in the reality of a creative individual career of wise and beautiful action. This notion cannot be exactly duplicated in other ancient literatures. It dominated the educational theory and practice of the Greeks and has entered into all subsequent Western culture.

It was an educational practice growing out of this aim which gave Athens the Age of Pericles.

Apropos of many of our curricular arguments of today it is interesting to note that the education which produced Athens did not until the sixth century B. C. include reading and writing, and until much later there was no mathematics or drawing. So great results were built principally on poetry, music, and athletics, none of which are in the best of repute in the higher educational circles of today.

Athens put its cultural treasures before its youth and sought through nurse, pedagogue, and inspirer the leadership of each youth into a free and harmonious development of a physical, emotional, and intellectual personality that would be both an individual and a good citizen. This in large measure was the education that Pericles, Sophocles, Euripides, Phidias, Thucydides, Aristophanes, Gorgias, Protagoras, Socrates, and Xenophon received.

Socrates denied the sophist claim that knowledge was only opinion and purely individual, and denied equally the previous sacredness of custom uncritically examined. Knowledge, he insisted, is universal and morality is knowledge applied. This is true in all the arts and equally so in the art of living, the highest of all arts. Information, so much stressed by the sophist and valued by the typically Greek curiosity, is only the beginning of knowledge and without importance until made the subject of systematic reflection and organization into universal categories or classes with imperative significance for the conduct of life both individual and civic.

The method of this reflection was so definite and carefully pursued that it has ever since been called the Socratic method. Socrates substituted discussion for the lecture characteristic of the sophists and sought to substitute the power to think or reflect in this systematic way for the mere collection of information or polished and plausible style. He contended that the man so trained would no longer be a merely clever and ambitious individual but a good man and a good citizen in an even deeper sense than the conforming youth of the older moral education of custom.

From 69 A. D. to 529 A. D. the University of Athens formed from the fusion of the Academy (of Plato), the Peripatetic School (of Aristotle) and the Stoic (of Zeno) enjoyed the support of the Roman emperors. A professional staff of ten to twelve leaders, aided by assistants and instructors paid by student fees, and the pedagogues of wealthy students gave courses of three to seven years to the youth of the empire. As a center of pagan influence it was suppressed by Justinian in 529 A. D.

In this quick sweep we have moved from the memorized incantations and rites of the medicine man to a university which plans social

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*MATHEMATICS, A LIVING SCIENCE**

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THE very word *mathematics* has long been a bugbear to many people. Many have the idea that it is a meaningless jumble of symbols, useful only for the engineer or professor, and of no value whatever to the ordinary man. This notion has gained much headway in this country, and has led to a more or less concerted movement toward abolishing mathematics as a requirement in our schools. On the other side of the ledger, we see evidences of awakened interest in mathematics on the part of the masses, as shown by the reception of certain books within the last year or so. One of these was the book "Number, the Language of Science" by Tobias Dantzig, published by the Macmillan Company and now in its second edition. Perhaps the most startling of all is the reception given to Hogben's recent book, "Mathematics for the Million," which as you know was for a year or so a best seller in England, was then reprinted in this country, and has for several months been a best seller here.

There are today, and I suppose it has been that same way since the time of Euclid, three main criticisms that I hear voiced concerning the study of mathematics. The first of these is that mathematics is such a difficult subject except for that relatively small number that have a special talent for it. The second is that mathematics is dead—that it is the same now that it was 2,000 years ago, and that it is a shame to have our live young American boys and girls studying a subject that is as dead as a dodo. The third is that mathematics is of no use to the average man, that it is of value only to the engineer, the physicist, or the professor who makes his living teaching it.

I propose to comment briefly on each of these points.

First, as to the difficulty of mathematics. It is indeed true that mathematics is by its nature different from many other studies. That is not because of the symbols employed either, although, to be sure, the signs and figures are quite mystifying to the uninitiated. But for many years mathematics was not symbolic but rhetorical, that is, all statements were written out in full, and it was precisely the introduction of symbols that freed mathematics from the fetters that enchained it. As Professor E. H. Moore aptly remarked, "The greatest aid to the development of any mathematical doctrine is the

* An address before the mathematics students of Duke University in Page Auditorium, Nov. 9th, 1937.

introduction of a suitable symbolism." In the course of this lecture I hope to show you in at least one case that this is certainly true. But the difficulty of mathematics is more deep-seated than that. Mathematics is a *structure*. Each proposition or theorem is built up on postulates, axioms, and theorems that come before, just as the first floor of a house is built upon the foundations, and the second floor is built upon the first, and so on. In most cases, it would be impossible for one to pick up a book on mathematics and read page 101 without previously having read the first hundred pages. Moreover, just as the cement in the foundation should be allowed to harden before the first floor is added on, so a little mathematics should be learned at a time, and should be assimilated or allowed to *set* as concrete does, before more mathematics is added to that. Otherwise, there is danger of mental indigestion, just as one would get physical indigestion if he attempted to devour a whole bull at one sitting.

Yes, mathematics is an exacting taskmaster. One cannot read a mathematics book as he would a novel, although to be sure, some students try to do so. When I was in college I heard of a student who studied mathematics in such an unusual manner that I must describe it to you. After a hearty dinner this student would return to his room in the evening and make detailed preparations for his task. He would first pull his big Morris chair over to one side of the fireplace. He would then bring up his smoking stand and place it close by. Next, he would take off his coat, slip on his lounging robe, pull an eyeshade down over his eyes, get out his big calabash pipe and settle himself in his chair. One final step and he would be ready for hard work. This consisted in removing his shoes and propping his feet up against the wall. And in order that his feet might not slide down, this ingenious young man had his bedroom slippers tacked to the wall! He thought he was now ready for work. But little work he did, as you can well imagine. He was too comfortable to cope with the difficulties that he encountered.

But mathematics is by no means as difficult as some would paint it, provided one gets started properly. Certain people simply give up with the statement that they have no talent for mathematics. That is partially correct. In spite of the assertion in our Declaration of Independence that all men are created equal, I venture to state that we are not all created equal. Our Lord Jesus Christ himself recognized that when he said, "And unto one he gave five talents, to another two, and to another one; to every man according to his several ability." For example I am quite sure that I could never write a symphony like those of Mozart, or an opera like

those of Wagner. However, I verily believe that I could at least learn to play a piano with some degree of proficiency provided I put my mind to it. So I believe that any person of normal mentality (I speak now of the *one talent* man), if he gets the right sort of start and learns at the outset how to direct his mental processes, can master without too great difficulty the required mathematics in our schools and colleges.

A moment ago I remarked that the difficulties of mathematics are not due to the symbolism, but are inherent in the structure of the subject itself. I am quite sure that some of my audience have already disagreed with me on this point. It is true that mathematics does employ a symbolism and a terminology which to the uninitiated is indeed mystifying. But in this respect, mathematics is no different from the other sciences. Chemistry employs a language of its own, so do physics and medicine, and not the least offender is radio. These technical terms are of great help to the scientist. They enable him to express succinctly ideas each of which without them would require many words, and even then might not convey all that the term implies. When we go to a drug store and ask for a tablet to relieve our headache, we might ask for some *aspirin*. But the chemist in his laboratory speaks of this same drug as *monoacetic acid ester of salicylic acid*. This name conveys to the chemist immediately the composition of the drug. So also the chemist uses symbols to represent his benzene ring, or his carbon atom, etc. We do the same in mathematics. Mathematics is not a language. If it were, it would certainly be a more universal language than Esperanto, since the symbols and equations are the same in practically all languages and dialects of the world.

Just to give you an idea of the importance of a proper notation, let us consider briefly an operation which is one of the simplest in all of mathematics and one which can be performed by any school boy today—I mean the multiplication of ordinary whole numbers such as 27 by 48.

The notion of the positive integer has been known ever since the dawn of human intelligence. It arose as a result of counting, as when primitive man counted his sheep or cattle. How long ago that was, of course no one knows, for even the lower animals have a number sense which enables them to distinguish certain numbers from others. For example, a crow is said to be able to count up to four, and as the German mathematician Hankel puts it, "Even a duck can count her young." At first when primitive man wished to represent the number *one*, he would do so by making one mark |, two he would represent by ||, and so on. But when he came to

such large numbers as 1,760 he found it necessary to use an abbreviated notation, rather than to write down 1,760 marks. Representing a number such as 100,000 was of course out of the question; but by the time we reach the period of ancient Egypt, we find that they employed a hieroglyph resembling a burbot, or fish, for this purpose. For representing 1,000,000 the Egyptians employed a symbol similar to that of a man in astonishment (quoting Cajori). Even the representation of a number such as 1,276,453 would have been to them something terrific, while to find its product by 452,178 would have been practically impossible. In our notation the problem of finding the product of 1,000,000 by 100,000 is so simple as to be almost trivial. But think of an Egyptian trying to find the product of a fish by a man in astonishment! Even when we come down to the time of the Romans, about 15 or 20 centuries ago, we find the symbol XXVII used for 27 and XLVIII for 48. Now suppose a Roman youth had to find the product of these two numbers. If you do not think it is difficult, just try it for yourself. Small wonder is it that few could multiply, and as for the division of relatively large numbers, that operation was practically impossible.

As a consequence the Romans made extensive use of the abacus, such as we now see in some Chinese laundries. They also had fairly complete multiplication tables, similar to the interest tables now used in banks. In other countries various devices were employed. By way of illustration, allow me to tell the following story:

Many years ago during a time of famine in Palestine an Israelite went down to Egypt for the purpose of buying grain. Upon his arrival he found that he could secure the desired provision, and the steward weighed out for him 48 measures of it. Upon being asked the bill, the steward replied that the price was 27 pieces of money per measure, but that he was unable to multiply so that it would be necessary for the Israelite to wait until the Pharaoh could multiply for him. At that moment the Pharaoh was deep in meditation, and, somewhat vexed at being disturbed, he declared that he was going to teach the steward how to multiply so that henceforth he need not be disturbed. The directions were to proceed as follows:

Place the 27 and the 48 in parallel columns. Under the 27 place 13, its quotient by 2, the remainder being disregarded. Under the 48 place its double 96. Similarly, under the 13 place 6, its quotient by 2, the remainder being again disregarded, while under the 96 we place its double 192. This process is continued until in the 27 column a quotient of 1 is obtained. From the 48 column delete those numbers, here 192, which correspond to even numbers, here 6, in the 27

column. The sum of the remaining numbers in the 48 column will then be the product of 27 by 48.

27	48
13	96
6	~~192~~
3	384
1	768
	1296 = 27 x 48

Thus, the process of multiplication is replaced by that of repeated halving and doubling, a process that the Egyptian could perform on his fingers, if necessary. This scheme is said to have been employed until fairly recently by certain peasant tribes in Russia.

At first glance, it seems quite remarkable that this process should work, especially since in the halving the remainders are always neglected. But it will always work, whatever be the two positive integers to be multiplied. The explanation is very simple, but I shall not stop here to give it. If you are interested I suggest that you ask your mathematics instructor to explain it to you. My purpose in giving it is that it shows what devices these peoples had to resort to in order to perform the simple operation of multiplication.

Now why is it that an operation that is so simple to us and which can be performed by any schoolboy today should have been such a terrific ordeal even to the best minds of those days? The answer lies simply in our improved system of numeration.

In the first place, the Romans had no symbol for zero. Indeed, this number zero did not come into our number system until about 1000 A.D. The symbol 0, which we call a cipher from the Arabic word *sifra* meaning *empty*, was introduced in the process of the development of the Hindu-Arabic notation for numbers. In that notation the value of a digit depends on the position that it occupies. Consider for example the digit 5 as occurring in the numbers 25, 51, 3512, 5213. In the first number, the symbol 5 stands for *five;* in the second the same symbol 5 stands for *fifty*, while in the third it stands for *five hundred*, and in the fourth, for *five thousand*. Here we have an illustration of the so-called *local value* or *place value*. When we write the number fifty-one in the symbolic form 51, the digit 1 pushes the 5 one place to the left and thus assigns to it the value fifty. But when we wish to symbolize the number fifty by itself, we have no digit to perform that service. Hence, the cipher was introduced.

It is no use to go further into the development of the Arabic

system of numeration, which, by the way, is not Arabic at all, but Babylonian-Hindu. That is a story in itself. Suffice it to say that with the symbols 1, 2, 3, . . . , 9, 0, alone we can write any positive integer, however large. Furthermore, in this system of numeration any schoolboy can multiply or divide any two numbers however large. To the Greek mathematician this would have seemed to be sheer impossibility.

So we see that the development of this new notation rendered extremely simple operations that hitherto had been almost impossible of performance. This serves to show that it is not the notations of present day mathematics that make the subject difficult. On the contrary, the introduction of suitable notations renders the operations simpler. But more than that, this introduction of new symbolism is an evidence of change and growth.

To be sure this change took place many years ago. And many people say that mathematics is now dead—that it has ceased to grow and improve. Even a professor of electrical engineering in one of our neighboring state universities remarked to me several years ago that no usable mathematics had been discovered within the past 60 years. I remarked to myself that it was doubtless true that *he* did not know how to use any of the mathematical discoveries of the past 60 years, but that a plenty had been discovered. And on several occasions "old grads" have returned, and in conversation with me have asked what courses I was giving. I replied that I was giving a freshman course, a course in analytic geometry and calculus, and a graduate course. To which the old grad would reply "Oh yes! I studied analytics under old Professor So-and-so 25 years ago. Same old stuff, I suppose." Nothing could be farther from the truth. The field of mathematics is constantly growing. New theories are being developed; old theories are being reworked so as to make the content richer and more practical and so as to render proofs simpler. This is especially marked in high school and college texts.

For example, some years ago when I was a student in high school, the algebra texts were simply filled with exercises inserted for the purpose of formal drill on such topics as the manipulation with fractions, work with radicals and exponents, and all sorts of simultaneous equations. Many of the problems were of the *hare and hound* type of which I mention the following:

A hare is 50 leaps ahead of a hound and takes 4 leaps to the hound's 3. But 2 of the hound's leaps are equal to 3 of the hare's. How many leaps must the hound take to catch the hare?

Now the problem is a good puzzle and perhaps it might serve to sharpen the student's wits. So did the Old Gold contest which was conducted a few weeks ago. But what practical contact does it have with daily life? A conscientious student might after some effort find that after 300 leaps the hound will catch the hare; and once having secured that valuable information, he might well be inclined to ask, "So what?" It might well be that long before the hound could take the necessary 300 leaps, the hare has run into some hollow log, or into a pile of brush and disappeared. I am glad to say that this type of problem has virtually disappeared from our texts. On the other hand, in our more modern texts less emphasis has been placed on formal drill which tends to become deadly, and more problems of the practical type have been included. By these I mean problems dealing with volumes of gas under pressure, such as would be met with in a chemical laboratory, or the electrical resistance of a wire as varying with the diameter of the wire in the physical laboratory, or the distance required for the stopping of an automobile as varying with its speed. Then again, instead of making up problems of little practical significance involving quadratic equations, the more modern text books now include problems concerning bodies falling freely under the influence of gravity. Such problems are of intense practical importance. Suppose, for example, that a Chinese aviator is flying at a height of 10,000 feet with a speed of 150 miles per hour, and that he wishes to drop a bomb on the Japanese flagship Idzumo anchored in the Shanghai harbor. This person, since he is an aviator, presumably has enough sense to know that he must not wait until he is directly over the ship before releasing the bomb. But it is not enough for him to know that. He must know how long it will take the bomb to reach the ground. Then knowing his own speed he can determine at what position he must release the bomb so that it will strike the ship. As we know from reading the newspapers recently, some of the Chinese aviators have not been good enough mathematicians to determine that, and as a consequence some of their bombs have fallen elsewhere than intended and with disastrous results.

This desire on the part of the textbook writers to make their books less formal is reflected in many of the more recent texts. I mention, for example, Snail's College Algebra, which in the discussion of the quadratic includes many problems concerning falling bodies. Griffin's Mathematical Analysis, which appeared in 1921 and which enjoyed a phenomenal success, is especially noteworthy in that respect.

In mathematics we deal with measurable magnitudes; i.e. with quantities to which a number may be attached, such as lengths, areas, volumes, speed, acceleration, temperature, voltage, resistance, horsepower, etc. Such quantities may be of two kinds, variable or constant. When we speak of a variable, we mean a quantity which throughout the course of the discussion may change or may assume different values. As examples of such quantities we may mention the temperature in this room, the population of Durham, the value of your car, your age, your bank account, the speed of a falling body, and so on without end. Note that we use the qualifying term *may change*. For example, the temperature in this room might over a considerable period of time remain the same. Similarly for the population of Durham. However, we call these both variables, since they are subject to change.

On the other hand, a constant is a quantity that throughout the course of the discussion does not change its value. Thus the number 2 is a constant, and in fact, all numbers are constants. 2 never was 1.99 and it never will be 2.01. It will always be 2. To be sure, we might have a platinum bar that was originally 2 feet long and it might become warm and expand to a length of 2.01 feet. But that is the length of the bar and not the 2 that has changed. Then again the ratio of the circumference of a circle to its diameter is a constant. If we take a large circle, measure the length of its circumference and its diameter accurately, and divide the length of the circumference by the length of the diameter, we obtain a number. If we take a small circle and repeat the operation we get the same number. If a person in Euclid's time had done the same thing, or if a person on Mars were to do the same thing now with a circle of any size, the same number would arise. We call this constant π, and its value is approximately 3.14159. It is one of the most important of all the constants.

Let us consider a second illustration. The great Greek philosopher Aristotle (384-322 B.C.) is reputed to have asserted that if two objects of different weights, say a 10 lb. lead ball and a 1 lb. lead ball, be dropped simultaneously from rest, the heavier ball will fall the faster. Just what were his reasons for this conclusion I do not know. He might have argued that the reason why an object fell at all was the attraction of the earth for it and since the heavier object was attracted the more by the earth, it would for that reason fall the faster. Of course we know now that this is not the case. Although the attraction of the earth for the 10 lb. ball is greater than for the 1 lb. ball, the inertia of the former is greater so that more force is required to put it in motion. But for almost twenty centuries Aris-

totle's dictum remained unrefuted. Galileo (1564-1642) was the first to abandon the idea. During the years 1589-91 he conducted experiments from the leaning tower of Pisa which led him to conclude that the acceleration of an object does not vary with the weight of the object, but is the same for all objects, or as we say, is a constant. This constant is called the acceleration of gravity and is commonly denoted by the symbol g. Its value is approximately 32.2 ft./sec.^{2} or 980 cm./sec.^{2} The physicist then writes as his formulas for falling bodies

$$s = \tfrac{1}{2}\, gt^2, \qquad v = gt$$

where s is the distance that an object falls in t seconds, and v is its velocity, while as he puts it, g is a constant. But is g really a constant? In the sense that we have defined the term it is. So long as we remain at one place and do not get too high above the surface of the earth, we may say that g is constant. But if we were to move from Chapel Hill to New York, g would change. That is why in our definition of a constant we added the qualifying phrase "in the course of the discussion." Thus the constant π differs from the constant g in the respect that the former is the same at all times and in all places, while the latter may change from place to place even on the surface of the earth. π is therefore an *absolute* constant, while g is not.

Most of the things that we think of are not really constant. Suppose that as we sit here we try to think up examples of things that are constant. We will find that it is really a difficult thing to do. Even the length of the standard meter bar that is kept in the Bureau of Standards in Washington is not constant. It varies slightly with the temperature. It was a realization of this state of affairs that led the old philosopher to exclaim, "Everything changes except the law of change itself."

But in most of the situations that we deal with we are concerned not with one variable only but with two or more. Moreover, these are not just any two variables but are variables that vary in some definite way with each other. For example, my weight and the temperature at the top of Mount Everest are variables, but we should not include them in the same problem for the simple reason that there is no connection between them—at least so far as we can determine. On the other hand we might consider in the same problem the barometric pressure and the elevation above sea level, for, as we know, the barometric pressure varies with the elevation; or a man's age and the premium he has to pay for a $1,000 life insurance policy; or the weight of a letter and the postage necessary to carry it in the

mails; etc. We are thus led to the notion of *functional dependence,* and we formulate the definition:

If one quantity, which we shall call y for lack of a more suitable symbol, varies in some definite way with another quantity x, then y is a function of x.

To be sure, this definition may not be mathematically free from objection, but it will do for our purposes. Thus we would say that the barometric pressure is a function of the elevation above sea level; the value of an automobile is a function of its age; the postage necessary to carry a letter is a function of the weight of the letter; and so on without end.

In this connection we usually call x the *independent* variable and y the *dependent* variable or *function.* In many cases the functional relationship will suggest to us which of the variables should be thought of as the independent variable. For example, we should consider the temperature in this room as varying with the time rather than the time as varying with the temperature. In this case the time would be the independent variable and the temperature the function. So we think of the premium on a life insurance policy as a function of the age of the insured rather than of the age as a function of the premium, etc.

But in many cases this distinction is not so sharp. Thus normally we might think of the barometric pressure as varying with the elevation rather than vice versa. But consider for a moment the situation of an aviator who is flying in a fog near a mountain range. Obviously it is very important that he know his elevation. Now there is on his instrument panel a device known as an *altimeter,* which is really little more than a barometer. By reading the barometric pressure the aviator can tell his altitude. In this case, therefore, we would think of the elevation as varying with the barometric pressure. Thus we see that we cannot always decide which should be the independent variable and which the function. For this reason perhaps it would be better if we formulated our definition as follows:

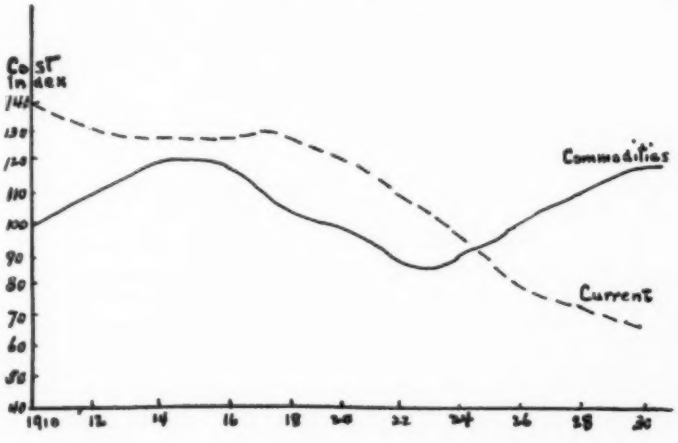
If one quantity y varies in some definite way with another quantity x, then x and y are functions of each other.

This is precisely what the mathematicians do. You will observe that the word *function* as employed in mathematics is used in a somewhat different sense from that of ordinary English parlance. It has been used in higher mathematics for many years and is now finding its way more and more into the elementary field, I am happy to say. Thus there is a tendency in many of the more recent elementary texts to make the notion of function the central idea.

Ever since the time of the French mathematician Descartes (about 1640) the functional relationship has been exhibited by means of a *graph*. Note that this word is spelled g-r-a-p-h, not g-r-a-f-t, as some students insist on spelling it. There is no graft in connection with this. The politicians have nothing to do with it. The word comes from the Greek word *graphein*, which means to *write*. A graph, then, is nothing more than a drawing or a picture.

Such drawings or graphs are now used very extensively in newspapers and magazines, in Government bulletins, in text books on economics and elsewhere to exhibit the production of cotton or the per capita public debt or the death rate from infantile paralysis as varying from year to year. They are used in chemistry and physics text books to exhibit relations between volumes of gases and pressure, the specific heat of water as varying with the temperature, etc. Even our United States Artillery uses graphs every time before firing one of our 12-inch seacoast rifles. For example if there is a 25-mile per hour head wind blowing across the line of fire at an angle of 15°, say, both the computed range and the direction of fire must be corrected for this before the shot is fired. By means of graphs these corrections are made accurately and quickly within a few seconds.

Sometimes a chart exhibits two or more graphs on the same sheet. For example, the charts put out by the power companies exhibit curves showing how the cost of electricity and the cost of other commodities has varied within the 20 year period from 1910 to 1930.

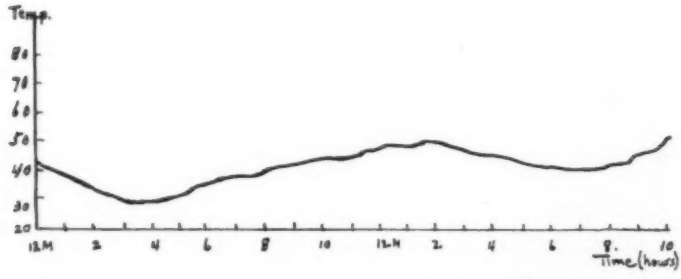


The current curve starts high and gradually comes down, at times more rapidly than at others. On the other hand the commodity curve starts low and gradually rises until now it is much higher than the current curve. The conclusion that is obviously intended to be drawn is that the cost of electricity is now so low in comparison with the cost of other commodities that we should buy more electricity.

Note that in both cases we consider the time as the independent variable and the other quantities as varying with it. Hence the time is plotted on the horizontal axis.

This sort of diagram can be used by anyone with even the most meager mathematical training, and can prove to be very useful and instructive.

One of the most interesting illustrations of the practical use of a graph was one that I saw in a store window in Charlottesville, Virginia. The instrument consisted of an arm free to revolve in a vertical plane around a fixed pivot. On the free end of the arm was a pointer, while near the center of the arm was attached one end of a spring, the other end being fastened to a point on the frame. Now as the temperature rose, the spring expanded and forced the end of the lever upward, and as the temperature fell the end of the lever dropped. If, then, there be placed under the tip of the lever a sheet of paper properly scaled, we have a good thermometer. If on the tip of the arm we place a penpoint filled with ink, then, as the temperature rises and falls, a mark is made on the sheet, and the device serves as a splendid maximum and minimum thermometer. However, with this the instrument is not complete. Instead of having the sheet of paper fixed, it is placed on a revolving drum which makes a complete revolution every 24 hours. The pen point then traces out a perfect graph, with time as the independent variable and temperature as the function.



This type of graph is very useful. For example, not only can we tell what the maximum temperature was for a certain day, but

we can tell at what time that maximum was reached. But this little picture has still further information to give us. For example we can see that between 2 and 5 A.M. the temperature was dropping; then it began to rise slowly; etc.

In other words, we can read two things from the graph. First, the *height* of the curve represents the temperature at a certain hour, while the *slope* or the *steepness* of the graph tells us whether the temperature was rising or falling, and how fast. I can well imagine how a little thing of this kind might prove to be very useful. For example, suppose a man should be leaving home for his work at 8:00 o'clock in the morning. The thermometer stands at 40°; but it looks as if the temperature might rise, in which case a light top coat would be all the wrap that he would need. But the question is, Is the temperature rising or falling, and how rapidly? With an ordinary thermometer, the man would have to stand and watch the instrument for a few minutes, and even then unless he delayed a considerable time he might not be able to find out. But with an instrument of the kind I have just described he can tell at once which way the temperature is going and can govern his actions accordingly.

Graphs of this kind are also available for showing barometric pressure, and are invaluable in making weather forecasts.

So you see we are led at once to a consideration of another idea connected with the notion of a function and its variable; viz., the notion of *rate of change*.

We can say that "the height of the graph represents the value of the function while the steepness of the graph represents the rate of change."

I shall not take the time here to give a technical definition of this fundamental notion. Suffice it to say that it is one of the most important notions in all of mathematics, and one which has the most important applications in all branches of science. If a student of analytical chemistry be given a piece of material with the instructions that he analyze it, the first thing that he learns to do is to find what elements compose the material. This is qualitative analysis, and is considered relatively easy. The next question is to determine just how much of each element is in the material. This is quantitative analysis, and is much more difficult but no less important. So today, a chemist is not content with knowing that if certain ingredients are mixed with others a certain reaction will take place; he now goes one step further and inquires as to the speed of the reaction.

This notion of rate of change is not a new one in mathematics. Historians tell us that the germs of the idea were found in the writings of the early Greek mathematicians about the third and fourth

centuries before Christ. Other mathematicians of the succeeding centuries considered the problem, but it fell to the lot of a youth of twenty-three to bring the idea into full fruition. I speak of Sir Isaac Newton, that transcendent genius considered by many to have been the greatest mathematician of all time. Newton shares with the German Leibnitz the honor of having discovered the differential calculus, that most marvellous achievement of the human mind, the gateway to all advanced mathematics and the foundation stone on which all modern science rests. Newton discovered the calculus in his attempt to solve the problem, "Given a quantity, find its rate of change." He was thus led to the notion of *fluxions* or *flowing quantities*. Leibnitz's discovery came about as a result of his attempt to find the slope of a tangent to a curve. We now recognize these as one and the same problem, and that they are solved by one and the same process, viz., *differentiation*. In the words of the poet (Alexander Pope):

> Nature and nature's laws lay hid in night,
> God said, "Let Newton be", and all was light.

Although it was granted to Newton to be called the discoverer of the calculus, he was preceded by a group of brilliant mathematicians who paved the way for him. It was a realization of this fact that led Newton modestly to declare, "If I appear to see farther than others, it is because I am standing on the shoulders of giants." One of these giants was Isaac Barrow, Newton's teacher, who in 1669 resigned his chair to his pupil Newton, whose superior abilities he recognized and frankly acknowledged. For the remainder of his life Barrow devoted himself to the study of divinity. It was doubtless of him that the poet spoke when he said:

> There was once a professor at Trinity,
> Who found the square root of infinity,
> But in counting the digits,
> He was seized with the fidgets,
> So he dropped science and took up divinity.
> This same professor at Trinity,
> Who dropped science and took up divinity,
> By cubic equations, he proved Revelations
> Were circular points at infinity.

For many years the calculus had been considered too difficult a subject for freshmen. The very mention of the word was sufficient to inspire them with awe. However, within recent years there has been a change of opinion in this regard. Practically without exception the present day unified books include at least one chapter on the calculus. During the past 15 years the speaker has taught classes

using unified books, and it has been his experience that the chapters on the calculus were no more difficult for the student than the chapters on algebra, and they have uniformly created more interest. In the text *Introductory Mathematics,* of which the speaker is one of the authors, calculus is used throughout after the third chapter. This was done advisedly, since this text book was written primarily for that great body of college students who would take only one year of mathematics, and the authors felt that it would be unfortunate indeed for a student to end his mathematical career without some slight introduction to that great branch of modern mathematics, the development of which is one of the greatest achievements of the human mind.

So you see that the mathematics taught in our schools today is not the *same old stuff* of a generation ago. It is constantly changing, at times perhaps more rapidly than at others, but changing nevertheless. I have touched briefly on the history of two great developments in mathematics, viz., the evolution of our system of numeration and the discovery of the calculus. But, you will object, these developments took place hundreds of years ago. That is correct, but mathematics is still growing. Never before in this country has there been such mathematical activity. Indeed, I feel that we are facing a golden age in mathematics. However, this is to be said, viz., that the field of elementary mathematics has been so thoroughly worked over that there seems to be little left to discover. Most of the discoveries are in the upper reaches of the science, and it takes many years for these to settle down to the level of our texts. That is why we do not see them. But a subsequent speaker on this program will tell us about that.

Then again, some persons assert that mathematics is of no use to the ordinary man. What do these persons mean when they say that it is of no use? If they mean that the ordinary person will not make his living by teaching it, or by building a bridge across a river, or by computing the orbit of a comet, I should be inclined to agree. And who is an ordinary man? Is the college man an ordinary man?

The question, "What advantage do I gain by studying mathematics?" is as old as the ages. The question was put to Euclid 300 years before Christ. Let me recount the following story, which is doubtless familiar to many of you.

It is said that Euclid was once teaching a young man geometry, when in the midst of the lesson the pupil interrupted with the question, "But what do I gain by learning these things?" Whereupon Euclid rang for a slave and commanded, "Bring the young man two pence, since he must make gain from what he learns."

But if the question, "What do I gain by studying these things?" must be raised, why pick on mathematics? How many of our young college men who study French will ever get to France or even will have a chance to make a living by translating French documents? Often in conversation with my students I have inquired as to what other courses they were taking. To which the student would reply, "I am taking English, history, chemistry and Spanish. I had two years of French in high school but when I came here I decided to take up Spanish instead. I thought perhaps sometime I might get into business in Mexico or Central America and my Spanish would come in well." But how many of these boys will ever get to Mexico or Spanish America? How many even will ever see a person with whom they will need to converse in Spanish? I dare say that the vast majority of them will never get closer to Mexico than Atlanta. But do I on that account agree that the student should not study Spanish? Most certainly I do not! Even if he never sees a Spaniard I feel that his study of Spanish should prove valuable to him. On one occasion Dr. Edwin Anderson Alderman, late president of the University of Virginia, was addressing his student body, and in the course of his speech he made the following remark, "Young gentlemen, you have come to the University of Virginia, not to learn how to *make a living,* but to learn how to *live.*"

In recent years certain parties have made radio attacks on the study of Latin and algebra in our high schools. These persons say that the pupil should confine his attention to those studies that would do him some good. Why doesn't he pick on geography? Isn't the same remark applicable? How many of these pupils will ever make their living out of geography? You will say that a man must know geography so that he may be able to find his way over our country. Oh no! anyone can find his way over our country simply by inquiring as to routes from railway or bus station agents. Even the most ignorant immigrants have found their ways to this country and many have made great financial successes with little or no knowledge of geography. Then why do we study these things? It is because a knowledge of them gives us a better understanding of the world in which we live, so that we can appreciate more deeply what is going on in the world around us.

We are living in a scientific age. Discoveries of the most marvellous kind come thick and fast. Many of these discoveries are based directly on mathematics. I do not expect the ordinary man to understand all the principles underlying these discoveries; but a knowledge of some mathematics will give him more of an appreciation of some of the principles on which they are based.

Let me give you an illustration. In our freshman course we consider the graph of the ordinary quadratic function

$$y = x^2 + 2x - 3.$$

When we have plotted this graph I point out to my students that this curve, and the graph of any quadratic function is a curve called a *parabola*. This curve is approximately the shape assumed by the cable of a suspension bridge, such as the Brooklyn Bridge, or the George Washington Bridge. It is approximately the path of a stone thrown (not directly upward) into the air. These facts should be of interest even to the ordinary man. But let us go one step further. The reflectors on an automobile headlight are parabolic reflectors. Now why should this be the case? Because there is a point within the parabola, called the focus, which possesses the property that if the bulb be placed there the rays of light as they are reflected are all parallel. Sometimes the light bulb is displaced slightly from the proper position, and the lights are "out of focus" as we say. But there is an adjusting screw on the back so that any garage man can refocus them. Does the garage man know the principle behind this? I doubt it. I doubt that Henry Ford, Alfred Sloan, Walter Chrysler know about the properties of the parabola. But they have engineers that do. How astonished the old Greek geometers Menaechmus, Dinostratus, Archytas, and others would have been if they could have looked 23 centuries into the future and could have visioned the conic sections, for which they had no idea there could be any practical use, employed in the manufacture of our present day automobiles.

Let me tell you of an experience of my own. In 1917 the United States entered the World War. Immediately a great crowd of young men, especially the college men, rushed to join the colors. Some entered the infantry, some the aviation, some the artillery, etc. I was one of 600 young men who went to Fort Monroe to take examinations for the heavy artillery. Those of us who passed the test were sent to camps for further training. I was then sent to Pensacola and for nine months was with the coast defenses of Pensacola. During that time the Government repeatedly sent scouts to scour the coast defenses for men who had had sufficient mathematical training to officer the artillery. It seems that at the outbreak of the war many technically trained young men had joined the doughboys as privates and were now in the front line trenches, from which it was not feasible to withdraw them. And officers for the artillery were needed. Perhaps you think mathematics is not necessary in artillery. If you are thinking of the 3-inch field gun, you may be right. They

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THE WORD-UNIT METHOD OF TEACHING TYPEWRITING

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SINCE the introduction of typewriting into the curriculum of our public schools, a great deal of study, discussion, and experimentation has been made regarding the methods of teaching the subject in an endeavor to improve the methods of presentation to the end that the students might be able to acquire the maximum of skill in the minimum of time. Until quite recently, and in most quarters at the present time, the center of interest has been the mastery of the keyboard. Many studies have been made in an attempt to determine which of the keys should be taught first, which finger should be used first, and in what order or sequence the keyboard should be taught. In reviewing these studies one is impressed with the fact that there seems to be very little difference in the results obtained by any of these various experiments.

For some time the writer has shared the opinion of teachers of typewriting that there should be an improved method of presenting the subject and that some radical departure would have to be made from the traditional way of teaching with the emphasis upon presenting the keyboard by individual letter keys.

Since enough experiments have been conducted to suggest quite conclusively that the traditional teaching of nonsense syllables, or of teaching any particular key first, or the use of any particular finger first is not significant, an experiment was decided upon based upon the following considerations.

1. Teachers of typewriting and authors of textbooks on the subject have almost universally had entirely the wrong objective in mind. This objective, as stated before, has been the teaching of the keyboard, whereas this experiment was based upon the consideration that the objective in teaching typewriting should be the executed word on the typewritten page.

2. The psychological principle that anything to be learned should be learned as nearly as possible, from the beginning, the way it is to be used afterwards would indicate that students in learning to type should learn to write complete words from the very beginning.

3. In presenting typewriting to beginning students, individual letter-keys should never be mentioned or brought to the attention of the student at all. The word should be presented as a unit so that

the sight of the word will stimulate the response necessary for the execution of the word as a unit instead of by separate and individual letters.

A preliminary experiment was conducted in the Washington High School of Sioux Falls, South Dakota, where the writer was teaching at the time, and subsequently the experiment was carried on with controlled groups in six different high schools, a total of 314 students being used in the experiment. The work was presented to the word-unit groups in the following way:

The usual preliminary instructions were given, of course, as to the proper position at the machine, the proper position of the fingers at the keyboard, and how to insert and remove paper from the machine. A chart was drawn on the board and marked off showing the section to be used by each finger and also the home keys. The keys of the home position were made solid so that the students could readily place their fingers on the home keys. The students were then instructed to release the carriage and move it to the extreme left so that the keys were locked. They were then instructed to start tapping the keys, beginning with the home keys and proceeding until each finger had used all the keys that it operates. The stencil lever was then explained and all of the machines set for stenciling. The tapping drills were again resumed with the students now using the space bar and the machine operating as in actual writing. The purpose of these drills was to familiarize the students with the use of the machine, the proper method of tapping the keys, and the keys that each finger operates.

After the tapping exercises, the students were started on actual typing. After assuming the proper position at the machine and placing their hands in the proper position at the keyboard, the students were instructed to place the second finger of the right hand on the third bank of keys and by striking it and the first finger of the left on its home key to write the word "if." The word was written on the board, the use of the fingers was demonstrated by pointing to the chart, and demonstration was made on the machine. After each member of the class had written a couple of lines of the word "if" the necessary instructions were given for writing "is" and "it". "He" was the next word and this was followed by "her" and "here." After these words were presented and drilled upon, the students were taken into sentence writing using the shift key. The sentences used contained only words that had been previously presented and drilled upon. The work then proceeded from sentences to short paragraphs, letters, and straight material.

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A SELECTED LIST OF TESTS AND TEST BATTERIES FOR USE IN HIGH SCHOOL COUNSELING

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SCOPE OF THE TESTS' ROLE IN COUNSELING

DEAN McCONN of Lehigh University has admirably expressed the importance of the test in counseling: "As far back as we have any record of school routines, teachers have always examined or tested, as well as taught. . . . . examining or testing we have taken for granted as something that anybody could do at any time. . . . . an emergent major role of examining is clearly guidance; a process in which we shall employ both achievement tests and all those other new kinds of tests (of general intelligence, special aptitude, interests, and personality) . . . ."[1] The tests' role then is counseling, or, putting it differently, testing is *a* phase of counseling. Following to a certain extent McConn's discussion of the role of tests in guidance, the following functions seem to be served by them: (1) Determination of pupils' aptness for various curricula within the school. (2) Determinations of specific disabilities and lacks which have caused failures in curricula selected. (3) Determination, in a general way, of the limitations of future vocational fields for students. (4) Determination of possible vocational choices in the light of (3). (5) Determination, within the obvious shortcomings of personality and adjustment tests, of causes of personal and social maladjustment.

The Situation at Hand. While the ensuing discussion may be applied, with limitations to be noted, to the general problem of tests in counseling, the author would prefer to set up a hypothetical school and community in which his list might be used, for the sake of concreteness of illustration. Let us say that the high school in which the tests herein discussed will be used is in a city of 35,000 population and has an enrollment of about 1700 pupils (boys and girls). The city is a small textile center, but it would be looked upon more as a residential city since a good portion of the population of the city are engaged in small businesses or are employed in various capacities in the local university. Inspection of our (hypothetical) data reveals that in our high school about one pupil in three is pursuing the commercial curriculum, one in four, the general curriculum (which admits, with proper certification, to the local university and

[1] McConn, C. M.: "Examinations for Guidance", *Occupations*, O., '36, p. 46.

other colleges in the state), one in five, the "college" curriculum (which rigorously points to college entrance examinations of various kinds), one in six, the home economics curriculum (really a misnomer, it should be called practical arts; it has an enrollment which is 40% male, 60% female).

The counselor is the only resident "tester." He is furnished limited clerical assistance for "scoring" tests, filing, etc. In acute problem cases he may consult the educational psychology department of the local university. He has had specific training in testing as well as guidance.

THE TESTS[2] SELECTED

(Ranking in order of importance within "fields" is given in parentheses)

Intelligence:

1—Stanford-Binet Individual Intelligence Examination[3] (1)
2—Stanford Group Test of Intelligence (2.5)
3—Otis Group Intelligence Test—Advanced Examination (2.5)
4—Army Alpha Revised (form 5) (4)

Achievement:

5—The Stanford Achievement Tests in High School Subjects (1)
6—Cooperative Test Service Achievement Battery (2)
7—Thorndike-McCall Reading Scales (3)

"Non-verbal" Intelligence:

8—Likert and Quasha: Revised Minnesota Paper Form Board Test (?)

Vocational Interest:

9—Strong Vocational Interest Blank (1)

Teachers' Rating Scales for Personality of Pupils:

10—B. E. C. Personality Rating Schedule (1)

Inventories of Personality:

11—Allport: Study of Personality (1)
12—Bell: Adjustment Inventory (1)
13—Bernreuter: Personality Inventory (1)

Mechanical Aptitudes:

14—Stenquist Mechanical Aptitude Test (?)

[2] Test as used in this connection means test, test battery, rating schedule, inventory.
[3] The 1937 revision of this test, now available, might make it feasible to withhold purchase of the old form. However, it also seems proper to advise hesitancy in introducing the new revision into the school set-up until more literature is available concerning results attendant to its use. The 1937 revision has two distinct advantages over the old form for use in counseling in high school. First, there are two forms available so that retesting can be done without danger of learning effect. Second, there are three levels (instead of one) of "superior adult" intelligence measured, giving a much more adequate sampling of abilities at the higher mental levels than the old test did. This test, old or new form, should only be used if the counselor is specifically trained in its administration.

In order of frequency of use, according to classifications, a "guessed at" ranking might be made as follows: (1) Intelligence, (2) Teachers' Rating Scales for Personality of Pupils, (3) Achievement, (4) Inventories of Personality, (5) Mechanical Aptitude, (6) "Non-verbal" Intelligence.

Tests of Intelligence

Stanford-Binet. This individual examination tests the kind of intelligence which successful school work requires. One of its chief advantages lies in the fact that countless studies have been made all over the country which have served to shed ample light upon just what the test tests and with what consistency it fulfils the function. Its use of course is restricted to a trained examiner, but once the technique of administration and scoring is mastered it takes little time to use in relation to the results and values gained from the results. The manual gives explicit information concerning the interpretation of the findings, the test's limitations, etc. The raw score yielded is mental age, an additional advantage for ready interpretation.

Stanford Group Test of Intelligence. This group examination was standardized with a composite criterion of grade location, age, total score on a two hour mental test, and ratings of the pupils by from two to five teachers on intelligence and quality of school work. Adequate norms with supporting data appear in the manual and in various studies in the literature. Directions for administration and scoring are furnished in detail. The testing time is within the usual 45-minute school period. Kelley's[4] judges rated it *1* on the junior high school level among similar tests and *2* (no *1*) on the senior high school level. The probable error of the test score, essential for ready interpretation, can be worked out from the data furnished for various samplings. Numerous studies (including the Harvard Growth Study) have used the test. Two forms are available for retesting and reliability studies.

Otis Intelligence Test—Advanced Examination. This test is a shade less useful than the Stanford Group Test. The two tests compare favorably on all criteria except frequency of use and consequently less is known about the Otis. Two forms are available.

Note: In some data furnished the author by Dr. Frank S. Freeman of Cornell University the following finding is pertinent to the present discussion. Of the following five tests, National Intelligence Examination, Dearborn Intelligence Test—Form C, Stanford Group Test, Ohio State Intelligence Test, and the Otis Advanced, the last named was most heavily weighted with "speed," i.e., results indicate that a person's ability to react quickly to the items in the Otis test determines to a large extent what his score will be.

[4] Kelley, T. L.: *Interpretation of Educational Measurements*, World Book Co.: Yonkers-on-Hudson, N. Y., 1927.

It should, therefore, be pointed out that this seems to limit the use of this test to measuring the kind of intelligence required in tasks where speed is a prime factor.

Army Alpha Revised (form 5). The justification of this test in a counselor's collection lies chiefly in the fact that it has been standardized on populations at large and consequently a pupil's showing on this test will place him in his intellectual niche as Mr. Public. Norms and scoring are straightforward and readily understandable. The time of administering is well within a class period (23 minutes working time). Administration is simple both for examiner and examinee. Studies have been made showing the intercorrelations of the sub-tests (*and they are low,* meaning minimal overlapping of functions measured by the sub-tests). Sub-test norms are available. Studies show high correlation between results on this test and what it takes for vocational success.

Stanford Achievement Tests. These tests are built by experts in the specific subject matter fields and test-building specialists. Reliabilities throughout the battery are high and they are furnished on fairly large samplings grade by grade. Administration and scoring are easy to learn, and the latter is facilitated by stencils. Many studies have been made which have used one or more of the tests in this battery.

Cooperative Test Service Battery. These tests have been constructed more recently than the Stanford Achievement Tests and show some distinct advantages over them. The manual is much more explicit and detailed about the administration and scoring procedures. A lengthy discussion is given for each specific test (in addition to the general discussion for the entire battery) of the functions measured. A second advantage is that Cooperative Test Service, the publishers, make it a business to handle problems which arise in the use of the tests. The publishers will also furnish data available from current studies.

Thorndike-McCall Reading Scale. Even though a reading scale is included in the Stanford Battery the cases of reading disabilities are so numerous as compared with other academic complaints that it seems wise to include an additional test in this field. Kelley's judges (vide supra) rated this test *1* among junior high school tests in this field and *2* among tests of reading ability on the senior high school level. The function measured is clearly stated in the manual; directions for administration and scoring are given; the time involved in administering is only 30 minutes; and the norms are expressed with sufficient exactness for various samplings to yield probable errors of test scores. Kelley lists several studies using the test.

Minnesota Paper Form Board. Tests of this kind are of uncertain value. *But,* the counselor can get at a crude estimate of intelligence not involved in learning (in the usual school subjects) with them. This particular test has been recently revised and is published by the Psychological Corporation. Studies contributing to the norms are listed in the directions. Various criteria have been used, with scores for the test on each, all scores being in terms of percentile rank. Two forms are available. This test might be used after previous administration of, say, the Stanford-Binet and some reading test. (This test might well be omitted without much hardship; perhaps a "better" form board test might be more acceptable although the latter requires individual attention and administration).

Strong Vocational Interest Blank. Twenty-six occupational profiles may be gotten from one administration of this test (but the scoring involved would be tremendous). It purports to show how the testee's interests compare with successful workers' interests in specific vocational fields. It is in no sense a test of vocational ability. It uses, as criteria, scores made by successful adults in the twenty-six occupations for which norms are furnished. Numerous studies have been published using the test and contributing to the norms. Administration and scoring is somewhat complicated, although it is straightforward. Various articles have been published on short-cuts in scoring, and certain places, e.g., Stanford University, will score the blanks for a nominal fee. Separate forms for men and women are furnished; also, separate forms are used depending upon whether the person (man or woman) is in school or in occupational life.

B. E. C. Personality Rating Schedule. The advantage of this instrument to the counselor is that if teachers keep a schedule for each youngster and the results of these schedules are kept on file in the counseling office the counselor may get a summary view of the pupil who may come to him for individual guidance. The directions for using the test are adequate. Scores yielded are for sub-scales as well as the composite.

NOTE: In school situations where teacher loads are heavy the use of this instrument is not recommended.

Allport's Study of Personality. This instrument is valuable in that it gives the pupil an opportunity to talk about himself on points which are pertinent to counseling. It has no value as an objective measure, however. It amounts to a schematized interview without the interview's consumption of counseling time.

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The Mathematics Column

Conducted by H. F. MUNCH

AT THE recent meeting of mathematics teachers of the North Central District, at Goldsboro, N. C., the topic was, Problems in the Teaching of Mathematics, with Possible Solutions. The meeting resolved itself into a round-table discussion.

The problem which received most consideration was that of making mathematics interesting to pupils. Two ways of accomplishing this were exemplified concretely in the classroom in which the meeting was held. The examples consisted of a number of geometric designs placed above the blackboard at both front and rear of the room, and of graphs drawn on the blackboard. Each design was cut out of white paper and fastened to a piece of colored cloth. Not only did the designs themselves show up well, but the colors chosen gave to the exhibit a very attractive appearance. It was really excellent work. The statistical graphs were well done, and colored crayon was used to good advantage to make them more appealing to the eye.

The teacher who directed their preparation responded to a number of questions. He explained that in two geometry classes approximately fifty per cent of the class time throughout the year was devoted to this and other allied types of work. He was enthusiastic about its value, particularly in stimulating interest.

There were some teachers in the group who, although recognizing the motivating value of such activities when used in moderation, felt that teachers of geometry might well carefully consider limiting more closely the amount of time that should be devoted to them. The idea was expressed, too, that a better way to motivate the study of mathematics was to develop in the pupil a thorough understanding of the subject as the work progressed from day to day, at the same time seeking to develop skill, both in manipulation and application. This development leads to a sense of power, which, in turn, brings a feeling of satisfaction and self-confidence and a liking for the subject. These are more lasting and stronger motivating influences than cutting out geometric designs. For we ordinarily like to do what we can do well and we are almost sure to dislike

what we cannot do well. These are sufficient causes for insisting on a thorough mastery of the work as the class proceeds.

In reply to a question whether the general mathematics text state-adopted for the eighth grade was satisfactory, one or two expressed the view that it was inadequate for the work which should be done.

The group went on record as favoring a list of several state-adopted textbooks for the work of each year rather than a single text. There was a feeling that this would make it possible for the local authorities to choose a text that would more adequately meet the needs of the local community.

It is to be regretted that more of the mathematics teachers of the district were not present, for those who were there were well repaid for attending.

EDITORIAL

(Continued from Page 1)

of the national educational system, and that their future progress will depend in no small measure on their success in keeping in touch with the best that is being done in secondary education throughout the country. It will therefore frequently publish articles written by men in other states who have a definite message for North Carolina teachers. . . . It will publish occasional articles dealing with aspects of elementary and higher education which are of interest to high school teachers."

How far these purposes have been carried out during the twenty years since these words were written, readers of the JOURNAL can best judge. As these years have gone by, the magazine has changed somewhat in organization and format and has adopted a rather less local tone as it has reached out to serve a more widely distributed body of readers. Apart from these changes, however, its original purposes still hold. Now, as then, it "will welcome articles that are definite and constructive, pointed letters on matters of general interest, . . . progressive movements in country and city high schools, and significant events in any part of the State," and beyond.

It is the hope of the present editorial board that the JOURNAL may, as its years increase, perform an even greater and wider service than it has in the past. To that end it bespeaks the cooperation of all those interested in the improvement of education, in the South especially, but more broadly as well.

The French Column

Conducted by HUGO GIDUZ

RECENTLY the N. C. State Department of Instruction sent a circular to all French teachers giving suggestions for the use of French Book I (Smith-Roberts), in schools with eight months' terms. If these suggestions are followed implicitly, and no additional reading is given the pupils, teachers will find that their pupils will not do the amount of reading required by the State Course of Study.

In order to fulfill these requirements it will be necessary for teachers either to take some of the lessons that it is suggested be omitted, or they will have to have the pupils do supplementary reading in some of the readers which are on the State Adopted List of Readers.

Another alternative is to have the pupils do outside reading from books supplied by the teacher. Most teachers have texts which they could make available to their classes. This may be done on a voluntary basis. The good pupils who are interested in their work will gladly do not only the required amount, but much more. The poorer ones may be held to the required minimum if the teacher so desires, or they may be permitted to do only the regular class work. Their outside reading will in all probability not amount to much anyway!

If we are to make reading the center of our instruction we should not omit too many of the reading lessons, and if the plans suggested are followed the pupils will be approximately 100 pages short of meeting the requirements of the Course of Study.

As I suggested in this Column in the November issue, it is best to run over into the second year with Book I, rather than try to cover all the lessons in one year, or to stop at the end of the first year wherever one may be and in the fall start with Book II.

The South Atlantic Modern Language Association met at Winthrop College, Rock Hill, S. C., during the Thanksgiving vacation. It was one of the finest and best attended meetings in the ten years of the Association's history. The meeting next year will be held at

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NOTES FROM THE FIELD

Reported by A. B. COMBS, N. C. State Department of Public Instruction

THE State Department of Public Instruction has sponsored a number of institutes or conferences in various subject fields during the first semester. Those attended by high school teachers included conferences in: science, physical education, English, art, music, safety education and the social studies. These meetings have been well attended and successful, due to the cooperation of the teachers. It is hoped that they will stimulate further study of the problems of instruction in the various administrative units.

High School principals and teachers will be interested in two summaries which have been made from the Principals' Annual Reports for the session 1936-37. The first summary shows the enrollments in high schools of various sizes and will be helpful to students and teachers who are studying the high school situation in the State. The second gives a summary of the high schools, showing the number of schools in each classification, the enrollment, average daily attendance, and number of graduates.

DISTRIBUTION OF ENROLLMENT BY SIZE OF SCHOOL
WHITE PUBLIC HIGH SCHOOLS, 1936-37

Size of School by Number of Teachers	Number of High School Units	*Number of Teachers	**Enrollment	Per Cent of Pupils	Cumulative Per Cent	Number of Pupils Per Teacher
1	3	3	87	0.05	0.05	29.00
2	20	40	922	0.63	0.68	23.05
3	81	243	6,500	4.48	5.16	26.74
4	145	580	15,755	10.86	16.02	27.16
5	135	675	17,804	12.27	28.29	26.16
6	97	582	15,989	11.02	39.31	27.47
7	73	511	13,885	9.57	48.88	27.13
8	55	440	12,949	8.93	57.81	29.20
9	32	288	8,585	5.91	63.72	29.80
10	15	150	4,271	2.94	66.66	28.47
11 - 20	53	738	23,855	16.45	83.11	32.32
Over 20	24	766	24,444	16.85	99.96	31.91
Totals	733	5,016	145,046	100.00	100.00	28.91

*All persons teaching 3 or more periods daily.
**The enrollment figures include pupils coded a, c and d.

Average number of teachers per high school 6.84
Average number of pupils per high school 197.87
Average number of pupils per teacher 28.91

99.32 per cent of pupils are enrolled in schools with 3 or more teachers.
83.98 per cent of pupils are enrolled in schools with 5 or more teachers.
48.88 per cent of pupils are enrolled in schools with 7 or fewer teachers.
51.12 per cent of pupils are enrolled in schools with 8 or more teachers.

WHITE PUBLIC HIGH SCHOOLS, 1936-37

	RURAL			CITY			TOTAL		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Number of Schools			641			92			733
Accredited			610			92			702
I-AA			1			36			37
I-A			3			10			13
I-B			1			1			2
II-A			494			45			539
II-B			111						111
Unaccredited			31						31
III-A			6						6
III-B			12						12
III-C			13						13
Number of Teachers	1,721	1,852	3,573	423	1,020	1,443	2,144	2,872	5,016
Enrollment	44,945	54,035	98,980	21,865	24,201	46,066	66,810	78,236	145,046
In Unaccredited Schools			1,923						1,923
Average Daily Attendance	38,253	47,941	86,194	18,957	21,546	40,503	57,210	69,487	126,697
*Per Cent in Attendance	85.11	88.72	87.17	86.70	89.02	87.92	85.63	88.81	87.34
ENROLLMENT:									
First Year	16,579	17,895	34,474	7,297	7,475	14,772	23,876	25,370	49,246
Second Year	12,096	14,458	26,554	5,858	6,445	12,303	17,954	20,903	38,857
Third Year	9,203	12,114	21,317	4,527	5,361	9,888	13,730	17,475	31,205
Fourth Year	7,067	9,568	16,635	3,701	4,411	8,112	10,768	13,979	24,747
Twelfth Grade				482	509	991	482	509	991
AVERAGE DAILY ATTENDANCE:									
First Year	13,662	15,504	29,166	6,224	6,597	12,821	19,886	22,101	41,987
Second Year	10,246	12,783	23,029	5,086	5,740	10,826	15,332	18,523	33,855
Third Year	8,003	10,863	18,866	3,953	4,786	8,739	11,956	15,649	27,605
Fourth Year	6,342	8,791	15,133	3,270	3,969	7,239	9,612	12,760	22,372
Twelfth Grade				424	454	878	424	454	878
Graduates	5,683	8,441	14,124	2,769	3,569	6,338	8,452	12,010	20,462

*Based on enrollment, codes, a, c and d.

NOTE: There were 8 schools, not classed as high schools, doing high school work. They employed teachers and enrolled 126 pupils.

The State School for the Blind is not included in the totals. This institution has 6 teachers with an enrollment of 35 pupils.

THE FRENCH COLUMN

(Continued from Page 33)

Gainesville, Florida. This will be the first time that the association has had a meeting so far south. Many will be glad of the excuse to go to Florida in November! Modern language teachers should plan long ahead to take this trip which will prove not only a pleasant outing, but a profitable one for their profession.

While on the subject of meetings it might be well to remember that the State meeting will be in Raleigh next spring. The modern language teachers of North Carolina should gather there in goodly numbers. We shall have further opportunity to discuss the new texts at that time.

BOOK REVIEWS

Developing a High School Chemistry Course Adapted to the Differentiated Needs of Boys and Girls. Margery S. Gillson. Bureau of Publications, Teachers College, Columbia University, 1937. vii + 95 pp. $1.60.

This doctoral dissertation, evidently prepared by a teacher of considerable practical experience, arrives, as the result of questionnaire studies, at the conclusion that the traditional chemistry course must be materially altered if it is to fit the needs of ordinary high school students and adult laymen. It points out that significant differences exist in the requirements of the two sexes. It also establishes criteria for selecting content in accord with these differences and needs, and lists the principles that seem to be both essential to an understanding of the science and frequently met in situations during later life.

The whole study is decidedly helpful and thought-provoking.

C. E. P.

Behind the Footlights. Charles C. Mather, Alice H. Spaulding, and Melita H. Skillen. Silver Burdett Company. 495 pages. $1.72.

The growth of the little theatre movement and the wide interest in all sorts of amateur productions of plays has led to a great outpouring of books on play production—most of them intended for the guidance of the producer or director or for first aid to dramatic clubs. More recently the introduction of courses in acting or in drama into many high schools has called forth books meant to be used as textbooks in these classes. As yet the authors, like the teachers of these new classes, seem a little uncertain of their ground—of just what they should or should not attempt to cover or how they should cover it.

The book under consideration, while offered as a textbook for high school students, is also a book for the guidance of the teacher. Part One contains a brief and perhaps necessarily superficial history of the drama, and a discussion of various types of plays with illustrative selections. Part Two deals with the techniques involved in acting. Part Three discusses the actual preparation of a production and treats of scenery, lighting, and rehearsals. Throughout there are many exercises (some apparently unnecessary, others excellent), projects, and brief well-chosen scenes for classroom acting.

The weakest part of the book is the chapter on "Effective Use of the Voice." It will hardly satisfy those teachers who have had much experience in correcting speech faults. They know that the author's statement, "concentrate on being understood, and the speech faults will take care of themselves," simply will not work. They know that many common faults cannot be corrected even by careful imitation, but only by showing the pupil exactly how the right sound is made. And that means that every good teacher of speech must know something about phonetics. He must know by what action or use of tongue, teeth, lips, palate, jaw, or nasal passages the various sounds of our speech are made. The authors give a paragraph to the sound of *ing* without telling how the sound is produced or mentioning the mispronunciation *ingg*, so common among many pupils of foreign parentage. Of the pronunciation *in* or *een* for *ing* they say, ". . . there is finally an utter lack of ability to put the tongue into the proper positions and make the proper movements to

produce the required sound." That "utter lack of ability" would give us *sin* for *sing* and *win* for *wing*. I wonder whether the authors have ever heard those pronunciations.

The statement on page 17 that Aeschylus introduced a second actor and Sophocles a third (made also in Barnett's The Greek Drama) is misleading. It seems to mean that Aeschylus had only two actors in a play and Sophocles only three.

The suggestions in regard to pantomine, characterization, and make-up seem good. The book as a whole is interesting and has many excellent illustrations. It ought to be a helpful adjunct to good teaching.

P. C. F.

Class Lessons in Singing. ANNE E. PIERCE and ESTELLE LIEBLING. Silver Burdett Company, 1937. 212 pp. $2.00.

The content and presentation of this text are similar to others written on the subject of vocal class methods. The chapter headings are those expected—Singing, Breathing, Quality of Voice, Vowels, Consonants, Stage Deportment, etc. Each chapter deals with its subject in a way familiar to vocal teachers who have read other texts on the subject of voice training.

The material is presented in a manner comprehensible to high school students, but no teacher should attempt to use this text or any other dealing with this subject without the prerequisite well stated in the Foreword of Miss Pierce's and Miss Liebling's book, namely, "an ear of the nicest precision, a refined catholicity of taste, an infinite capacity for taking trouble, and knowledge extending over the whole domain of music."

Songs for study, included in the book, are songs with which all students should be familiar and are therefore well chosen. All are very singable. A list of songs for solo voices and ensemble groups, a glossary of Musical Terms, and keys to the pronunciation of Italian, German and French are included in the appendices.

JOHN E. TOMS.

HISTORICAL BACKGROUNDS OF EDUCATIONAL THEORY

(Continued from Page 6)

leadership through the power which results from knowledge. It may not be amiss to point out here that the "knowledge which was power" of Socrates was primarily that knowledge of the power of the mind and an emancipated creative self which moved freely and used constructively whatever existed in the way of knowledge of things, history, or gods. We have frequently quoted Socrates to justify an occupational education for utility, giving us power over nature. There are signs that while gaining power over nature we have lost power over man.

There is not time to sketch the course of higher education further in the familiar history of the rise again of university in the middle

ages. Faculties of law helped the emperors gain power independent of the church. Faculties of theology and dialectic prepared the mediaeval students to solve the current problem of the relation between faith and reason, and for careers of leadership in the church and the state.

Education was predominantly for that "Other World" of Platonic Cosmology. Its central method was drill in Aristotelian dialectics. Its content was traditional—Arts of Greece, Laws of Rome, Religion of Judea. The emphasis on human value in the Renaissance, the individualism and ethical this worldliness of the Protestant Movement, the naturalism and developmentalism of science, particularly biological science—these currents have overwhelmed and disrupted the mediaeval synthesis. The "modern" philosophy of education, particularly American education is still being formulated.

MATHEMATICS, A LIVING SCIENCE

(Continued from Page 23)

shoot once and if they do not hit the target, they change the range and fire again. But when one fires a 12-inch shell that weighs almost a ton, he must fire to hit. Ranges must be computed and then corrections must be made for the wind, for the dampness of the powder, for the density of the atmosphere, for the curvature of the earth, etc., and only a man with some mathematical training can do that. If a battery is too slow in scoring a hit, it may never score one at all.

Let me give you another of my experiences. One day while standing in front of the post office in Chapel Hill, Dean Manning of the University Medical School accosted me. "Browne, are you going to give a course in differential calculus this fall?" "Yes," I replied, "we are." "Well," he said, "I am going to send my son Isaac over to take it. I want him to have the integral calculus too. He is going to the Harvard Medical School next year. The medical journals are simply full of articles involving the calculus. I can't read them, but I want him to be able to."

You may reply that you have no expectation of being an artillery officer, a doctor, or a scientist. With all the wars and rumors of wars that are current in the world today, some of us may be soldiers sooner than we expect, and we look to the college man to take the lead. But even if we are not officers, doctors, or scientists, when we read in a newspaper or magazine of a discovery by some scientist, it is a source of satisfaction to us to have some idea of the principles that underlie that discovery.

THE WORD-UNIT METHOD OF TEACHING TYPEWRITING

(Continued from Page 25)

The groups were tested by the Blackstone Stenographic Proficiency tests and the regular typewriter company straight copy tests and marked by the International rules. Tests were given at the end of each two six-weeks grade periods and at the end of the semester. Space will not permit the exhibition of tables showing the results of each of the tests, but suffice it to say that the results of both the Blackstone tests and the company tests showed a superiority of the word-unit groups over the traditional groups of from 20 to 30 per cent in highest scores, median scores, lowest scores, and number of perfect papers, for each of the six-weeks periods and at the end of the semester.

In view of the fact that the teachers co-operating in this experiment were entirely unfamiliar with the word-unit method and had never taught it before, whereas they were experienced in the traditional method, and since they had only mimeographed instructions and materials to work with in the word-unit classes while they had their regular texts, supplementary materials, and outlines for their traditional method classes, it seems to the writer that since the results were significantly better for the classes taught by the word-unit method, the method is worthy of being studied and tried out by teachers of typewriting.

A SELECTED LIST OF TESTS AND TEST BATTERIES FOR USE IN HIGH SCHOOL COUNSELLING

(Continued from Page 30)

Bernreuter's Personality Inventory. This test purports to measure six aspects of personality, using in four cases criteria built from other tests of the same functions and in two cases inherent criteria of larger traits within the test itself. The procedure for standardizing the first four measures was to obtain groups of subjects exhibiting these four aspects of personality in extreme degrees, then to set up norms from their scores on the Inventory being discussed. The Inventory is self-administering; all necessary directions are printed on the pupil's blank. It may be administered in a group. Norms are expressed in such fashion that probable errors of test scores may be obtained. Numerous studies appear in the literature which have used the test. Scoring is facilitated with stencils.

Bell's Adjustment Inventory. The inclusion of this second inventory in the list is justified on this basis: First, the general results from the two on their common phases make a good basis for com-

parison. Second, Bell's test also includes a score on "Health Adjustment" of which he states: "The results of the Health Adjustment section should be considered not as taking the place of a medical examination but rather as a possible preliminary to such an examination. Unsatisfactory scores on this section may indicate the need for a physical examination by a physician." The norms are couched in more exact language than are those of the Bernreuter (vide supra). Probable errors of test scores are tabled. Criteria were "judgments of experts on the four traits." The manual furnishes results of validity studies which have been made.

Stenquist Mechanical Aptitude Test. This test purports to measure a special intelligence, "mechanical aptitude", which correlates low ($r = .2$ to $.4$) with general intelligence as measured on recognized and widely used instruments. The author of the test recommends its administration in connection with the usual "abstract intelligence" test (e.g., the Stanford Group Test). Norms are furnished on a large sampling (2000 cases) and are expressed in percentile ranks and T-scores. Scoring keys are easy and quick to use. Directions for administering are lengthy and require some practice for proper handling. The format of the test appears to be in need of revamping but at present it is the best test available in the field.

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